Nutrition Support in Critical Care
PARENTERAL AND ENTERAL NUTRITION WORKSHOP

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It is time we face reality, my friend ... We’re not exactly rocket scientists
“….Systems respond to pathogens by maintaining cellular homeostasis…”
Goals Have Changed From Adjunctive Care to “Therapeutic” Strategy

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**Previous goals**
- Attempt to preserve lean body mass
- Avoid metabolic complications
Objectives

- Does Nutrition support influence morbidity and mortality?
- Should nutrition be given enteral versus parenteral?
- Nutritional formula: calories, protein, supplements ..... 
- Clinical practice guidelines (CPGs) Evidence Based ...
Goals Have Changed From Adjunctive Care to “Therapeutic” Strategy

**Current Goals:** “Therapy not support”

- Attenuate metabolic response
- Reverse loss of lean body tissue
- Prevent oxidant stress
- Modulate immune response
  - Appropriate macro and micronutrients
    - Glutamine, arginine, omega-3-FA, antioxidants
- Meticulous glycemic control
Nutrition: double-edged sword
Nutritional Concerns in Critical Illness

Negative Nitrogen Balance

Protein Wasting
Protein Supplementation in Renal Failure?

- **CRRT**
  - Protein 1.5-2.5 gm/Kg/day IBW

- **HD**
  - Protein 1-2 gm/Kg/day IBW

- **Non-Dialysed**
  - Protein 0.5-0.8 gm/Kg/day IBW
Evidence-based Clinical Practice Guidelines Nutrition Support in the Critically ill

www.criticalcarenutrition.com

Daren K. Heyland MD
Queen’s University, Kingston, ON
Believe only half of what you see and nothing that you hear.
Special Interest

The following article is one of two articles offered for continuing education credit in this issue. Please see page 382 for details.

Canadian Clinical Practice Guidelines for Nutrition Support in Mechanically Ventilated, Critically Ill Adult Patients*

Daren K. Heyland, MD, FRCPC, MSc*; Rupinder Dhaliwal, RD*; John W. Drover, MD, FRCSC, FACS†; Leah Gramlich, MD, FRCPC‡; Peter Dodek, MD, MHSc§; and the Canadian Critical Care Clinical Practice Guidelines Committee

From the *Department of Medicine and the †Department of Surgery, Queen’s University, Kingston, Ontario; ‡Department of Medicine, Division of Gastroenterology, University of Alberta, Edmonton; and §§St. Paul’s Hospital, Center for Health Evaluation and Outcome Sciences, Vancouver, British Columbia, Canada.
<table>
<thead>
<tr>
<th>CONDITIONS</th>
<th>LANGUAGE OF RECOMMENDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>No reservations about endorsing intervention.</td>
<td>“strongly recommend”</td>
</tr>
<tr>
<td>Evidence supportive but minor uncertainties about safety, feasibility, or costs of intervention.</td>
<td>“recommend”</td>
</tr>
<tr>
<td>Supportive evidence weak and/or major uncertainties about safety, feasibility, or costs of intervention.</td>
<td>“should be considered”</td>
</tr>
<tr>
<td>Inadequate or conflicting evidence.</td>
<td>“insufficient data”</td>
</tr>
</tbody>
</table>
Canadian Practice Guidelines

- EN vs PN
- Early vs delayed EN
- Dose of EN
- Composition of EN
  - Arginine
  - fish oils
  - Glutamine
  - CHO/fat, Protein, fiber
  - pH
- Strategies to optimize EN
  - Feeding protocols
  - Motility agents
  - Small bowel feeding
  - Body position
- EN other
- EN in combination with PN
- PN vs. standard care
- Composition of PN
  - BCAA
  - Type of lipids
  - Zinc
  - Glutamine
- Strategies to optimize PN and minimize risks
  - Use of lipids/hypocaloric
  - Mode of lipid delivery
  - Intensive insulin therapy
- Antioxidants
  - combined
  - selenium

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  - combined
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Parenteral Nutrition In the Critically Ill

Figure 3b. Results of Subgroup Analyses

Mortality
- Malnourished
- Non-malnourished
- Quality score <7
- Quality score >=7
- Published before 1989
- Published after 1989
- Lipids
- No Lipids
- Critically Ill
- Surgical
- Overall Effect

Risk ratio (log scale)

TPN Beneficial
TPN Harmful

Mortality

$\text{No Benefit}$

$\text{No Benefit}$

$p=0.12$

$p=0.07$

$p=0.025$

EN vs. PN in the Critically Ill

Comparison: 01 EN vs PN
Outcome: 01 Infectious complications

<table>
<thead>
<tr>
<th>Study</th>
<th>EN n/N</th>
<th>PN n/N</th>
<th>RR (95%CI Random)</th>
<th>Weight</th>
<th>RR (95%CI Random)</th>
<th>Year</th>
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</thead>
<tbody>
<tr>
<td>Adams</td>
<td>15 / 23</td>
<td>17 / 23</td>
<td>0.88[0.60,1.30]</td>
<td>28.2</td>
<td>0.88[0.60,1.30]</td>
<td>1986</td>
</tr>
<tr>
<td>Kalfarentzos</td>
<td>6 / 18</td>
<td>15 / 20</td>
<td>0.44[0.23,0.90]</td>
<td>14.6</td>
<td>0.44[0.23,0.90]</td>
<td>1997</td>
</tr>
<tr>
<td>Kudsk</td>
<td>9 / 51</td>
<td>9 / 51</td>
<td>0.87[0.04,1.85]</td>
<td>14.6</td>
<td>0.87[0.04,1.85]</td>
<td>1992</td>
</tr>
<tr>
<td>Moore 1982</td>
<td>19 / 118</td>
<td>11 / 21</td>
<td>0.72[0.54,1.52]</td>
<td>13.2</td>
<td>0.72[0.54,1.52]</td>
<td>1992</td>
</tr>
<tr>
<td>Woodcock</td>
<td>6 / 16</td>
<td>11 / 20</td>
<td>0.44[0.23,0.90]</td>
<td>14.6</td>
<td>0.44[0.23,0.90]</td>
<td>2001</td>
</tr>
<tr>
<td>Young</td>
<td>5 / 28</td>
<td>4 / 23</td>
<td>1.32[0.53,3.28]</td>
<td>6.3</td>
<td>1.32[0.53,3.28]</td>
<td>1987</td>
</tr>
<tr>
<td><strong>Total(95%CI)</strong></td>
<td>60 / 254</td>
<td>104 / 244</td>
<td>0.61[0.44,0.84]</td>
<td>100</td>
<td>0.61[0.44,0.84]</td>
<td></td>
</tr>
</tbody>
</table>

Test for heterogeneity chi-square=7.94 df=5 p=0.16
Test for overall effect z=-3.00 p=0.003

**EN better than PN**

Favors EN  Favors TPN

Gramlich, Heyland Clinical Nutrition 2004
A metaanalysis of treatment outcomes of early enteral versus early parenteral nutrition in hospitalized patients*

John Victor Peter, MBBS, MD, DNB (Med); John L. Moran, MBBS, FRACP, FANZCA; Jennie Phillips-Hughes, RN

Less infections with EN

RD 7.9%, p=0.001
Heterogeneity p=0.07
Death by Parenteral Nutrition
Early Feeding

- Start 24 hours after ICU admission with polymeric formula
- Early feeding benefit with 1/3 - 2/3 of needs for days 1-5
- Start with full-strength 15-25 ml/hour
- Reduce to 1/2 rate during acute hypotension
- Check residuals q4h

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Patient well resuscitated and hemodynamically stable

Early (<48 h)

Mortality
- Trend toward reduction
- Trend toward reduction in infections

Nutritional endpoints:
- significant improvements

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Achieve target on day 1
Only in severe head injury

Mortality
- No difference

Other endpoints:
- More calories and protein
- Less infections
- More rapid recovery

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Nutrition Goals for the Stressed ICU Patient

<table>
<thead>
<tr>
<th>Patient</th>
<th>Feeding Level (kcal/kg)</th>
<th>By Indirect Calorimetry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal weight patients</td>
<td>25-30 kcal/kg</td>
<td>REE** × 1.0</td>
</tr>
<tr>
<td>Underweight patients</td>
<td>35-40 kcal/kg</td>
<td>REE × 1.2</td>
</tr>
<tr>
<td>Obese patients</td>
<td>20-25* kcal/kg</td>
<td>REE × 0.85</td>
</tr>
<tr>
<td>Morbidly obese patients</td>
<td>10-20* kcal/kg</td>
<td>REE × 0.75</td>
</tr>
</tbody>
</table>

* Use adjusted energy expenditure
** Resting energy expenditure is commonly 5%-10% higher than measured

ACCP 1997 recommendation
25 kilocalories/Kg per day
First week of illness

Reffeeding syndrome 20 kilocalories per kilogram per day
When the Obese Have “Surgery”
(Leaks, Sepsis, Pneumonia, ARDS)

- Aggressive nutritional support critical
  - Protection of lean body mass difficult
- Enteral far superior to parenteral
- Hypo-caloric, high protein intake
  - 11 to 14 kcal/ kg/day of Actual BW
  - 22 to 25 kcal/Kg/day of Ideal BW
  - BMI 30-40: 2 gm of protein per kg IBW
  - BMI >40: > 2.5 gm of protein per kg IBW
- Increase anti-oxidants secondary to significant increase in inflammatory response
  - Obesity is a pro-inflammatory condition
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Arginine
- Higher mortality in sepsis

Fish oils (omega-3 fatty acids)
- better outcome in ARDS

Glutamine in EN
- better outcome in burn and trauma patients

Protein
- better outcome with polymeric formula

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## Clinical Outcomes Using Omega 3 Fatty Acids in ARDS/ALI

<table>
<thead>
<tr>
<th>Author</th>
<th>Journal</th>
<th>n</th>
<th>Model</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gadek</td>
<td>CCM 99</td>
<td>146</td>
<td>ARDS</td>
<td>↓ ICU length of stay</td>
</tr>
<tr>
<td>Nelson</td>
<td>JPEN 03</td>
<td>98</td>
<td>ARDS</td>
<td>No Significant Change</td>
</tr>
<tr>
<td>Bracht</td>
<td>CCM 03</td>
<td>67</td>
<td>ALI / ARDS</td>
<td>BALF IL Leukotriene B4</td>
</tr>
<tr>
<td>Meyer</td>
<td>Am J Resp CCM 03</td>
<td>63</td>
<td>Sepsis</td>
<td>↓ inflammatory response</td>
</tr>
</tbody>
</table>

*Early Versus Delayed Enteral Feeding and Omega-3 Fatty Acid/Antioxidant Supplementation for Treating People With Acute Lung Injury or Acute Respiratory Distress Syndrome (The EDEN-Omega Study)*

*This study has been terminated.*

( The Omega arm of this study was stopped for futility. The EDEN arm continues to recruit patients as a separate independent study. )

Study NCT00509180  Information provided by National Heart, Lung, and Blood Institute (NHLBI)
First Received: January 31, 2008  Last Updated: April 16, 2009  [History of Changes](#)
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Feeding protocols
  - More calories in less time

Motility agents
  - (metoclopramide & erythromycin)
  - narcotic antagonists (naloxone & alvimopan)

Small bowel feeding
  - More success meeting goal rate
  - Less infections

Body position
  - Less VAP

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Gastric Residual Volumes
Consensus Statement

GRVs >500cc:
- Withhold feeds
- Reassess tolerance

GRVs 200-500cc:
- Careful bedside evaluation
- Initiate algorithmic approach

GRVs <200cc:
- Appear to be well tolerated
- Ongoing evaluation of risk

McClave, Demeo  JPEN 2002;26(6):Supplement
Motility Agent
Special ICU Patients

- Pulmonary failure
  - Pulmoncare?

- Liver failure
  - Hepatic formula with BCAA

- Renal failure
  - Nepro with Low protein

- Acute pancreatitis
  - Elemental?

- ARDS
  - Lipid (omega-3 fish oil), antioxidants

- Morbid obesity ....
Multicentre, cluster-randomized clinical trial of algorithms for critical-care enteral and parenteral therapy (ACCEPT)


Hypothesis: Evidence-based algorithms to improve nutritional support in the ICU improve patient outcomes
At ICU admission: Should this patient be fed?

- No
  - Acceptable conditions:
    - Tolerating adequate oral diet
    - < 24 h to oral intake
    - Palliative care

- Yes
  - Can EN be started within 24 hours?
    - No
      - Acceptable conditions:
        - Acute pancreatitis*
        - Enteric anastomosis*
        - Ischemic bowel
        - Enteric fistula
        - Imminent bowel resection
        - Imminent endoscopy
        - Bowel obstruction
        - High nasogastric losses
        - Severe exacerbation of inflammatory bowel disease
        - *May still opt for elemental enteral feeding
    - Yes
      - Gastric challenge: Use full-strength concentration
        - Consider prokinetic with challenge
        - Goal: at least 80% of requirements at 72 h
        - Assess q12h

- Yes
  - Is progression on target to reach at least 80% by 72 h?
    - No
      - Begin TPN
        - Reassess q12h for EN eligibility
    - Yes
      - Increase rate to 100% of requirements
        - Use prokinetic
        - Use postpyloric tube
        - Is goal met?
          - Yes
            - Continue EN to maximum tolerated
            - Supplement with PN
          - No
            - Continue EN challenges q12h
Assess gastrointestinal tolerance to tube feeding q4h

Intolerant patients have:
- Clinically significant stools or
- Readily apparent abdominal distension or
- Increased abdominal girth or
- Multiple emetic episodes or
- Clinically detected aspiration or
- Gastric residuals > 200 mL for nasogastric feeds
Multicentre, cluster-randomized clinical trial of algorithms for critical-care enteral and parenteral therapy (ACCEPT)


<table>
<thead>
<tr>
<th>Outcome</th>
<th>Control</th>
<th>Intervention</th>
<th>p value</th>
<th>Design effect*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital mortality rate, %</td>
<td>37</td>
<td>27</td>
<td>0.058</td>
<td>1.79</td>
</tr>
<tr>
<td>Mean hospital stay, d</td>
<td>35</td>
<td>25</td>
<td>0.003</td>
<td>20.33</td>
</tr>
<tr>
<td>Mean ICU stay, d</td>
<td>11.8</td>
<td>10.9</td>
<td>0.7</td>
<td>9.16</td>
</tr>
</tbody>
</table>

*Design effect values are based on the assumption of a common variance between clusters.
Multicentre, cluster-randomized clinical trial of algorithms for critical-care enteral and parenteral therapy (ACCEPT)

“Anorexia Protocolis”

Gary P. Zaloga, MD, FCCP
Larry Bortenschlager, MD
Indianapolis, IN
Monitoring Nutrition

- **Albumin**
  - Yes- Emergency Room/Pre-OP
  - No- ICU

- **Pre-Albumin**
  - No- Initially
  - Yes- After 5-7 days

- **Ratio of CRP/Pre-Albumin**
Recommendations to Enhance Success of ICU Nutrition Therapy

Summary

- Use nurse or dietician driven protocols
- Set criteria for discontinuation of enteral feeding
- Consider enteral a priority once patient is resuscitated
- Quality of nutrition appears more critical than quantity
  - specific nutrients supplementation
- Morbidly obese
  - Permissive underfeeding with high protein & antioxidants
- DO NOT push calories to GOAL too early
Quote of patient in MSICU ....
Quote of patient in MSICU ....
Quote of patient in MSICU ....

So “feed the prisoners”